

What is claimed is:

1. A method of printing with a flexible number of passes, comprising:
obtaining print data having a content defined by data elements
corresponding to a pattern of dots of a colorant;
5 determining if at least one constraint on distribution of the print data exists
so that forming the pattern in only one pass is precluded, and, if the at least one
constraint exists, then:
 - 10 (a) distributing subsets of the data elements, corresponding to
interspersed sub-patterns of the pattern, to a number of pass assignments,
the number and the subsets being determined by the content of the print
data and the at least one constraint, and
 - (b) delivering the colorant to overlapping regions of a print medium with
passes performed according to the pass assignments to form the pattern.
- 15 2. The method of claim 1, wherein obtaining print data includes
receiving a contone form of the print data and converting the contone form to a
halftone form of the print data, and wherein distributing is performed with the
halftone form of the print data.
- 20 3. The method of claim 1, wherein delivering is performed with a
printhead having a plurality of nozzles, and wherein determining includes
obtaining a constraint corresponding to a limit on at least one of a rate of firing
and a frequency of firing of at least a subset of the plurality of nozzles.
- 25 4. The method of claim 1, wherein delivering is performed with a
printhead having a plurality of nozzles, and wherein determining includes
obtaining identification of a subset of the nozzles that should not be used for
delivering.

5. The method of claim 1, wherein distributing is performed sequentially to select and remove different subsets of the print data until at least substantially all of the data elements have been selected and removed.

5 6. The method of claim 1, wherein distributing is performed as a sequence of selections including a first selection and one or more subsequent selections, with each selection creating one of the subsets of the print data and a remaining portion of the data elements, and wherein each subsequent selection is performed on the remaining portion that is present when each subsequent
10 selection is initiated.

7. The method of claim 6, wherein creating the remaining portion for at least one of the selections includes comparing the subset of the print data created by the at least one selection with a remaining portion of the print data
15 present when the at least one selection was initiated.

8. The method of claim 1, wherein distributing is performed without a predefined mask.

20 9. The method of claim 1, wherein distributing is performed with an algorithm.

10. A method of printing with a flexible number of passes, comprising:
obtaining print data including data elements corresponding to a pattern of
dots of a colorant included in a swath;

5 determining if at least one constraint on distribution of the print data exists
so that forming the pattern in only one pass is precluded, and, if the at least one
constraint exists, then:

10 (a) distributing subsets of the data elements with an algorithm to a
minimum number of pass assignments permitted by the at least one
constraint and the print data, the subsets corresponding to interspersed
sub-patterns of the pattern, and

(b) delivering the colorant to overlapping regions of a print medium with a
minimum number of passes corresponding to the minimum number of
pass assignments to form the pattern.

15 11. The method of claim 10, wherein obtaining print data includes
receiving a contone form of the print data and converting the contone form to a
halftone form of the print data, and wherein distributing is performed with the
halftone form of the print data.

20 12. The method of claim 10, wherein delivering is performed with a
printhead having a plurality of nozzles, and wherein determining includes
obtaining a constraint corresponding to a limit on at least one of a rate of firing
and a frequency of firing of at least a subset of the plurality of nozzles.

25 13. The method of claim 10, wherein delivering is performed with a
printhead having a plurality of nozzles, and wherein determining includes
obtaining identification of a subset of the nozzles that should not be used for
delivering.

14. The method of claim 10, wherein distributing is performed sequentially by the algorithm to select and nullify the subsets of the print data until at least substantially all of the data elements have been selected and nullified.

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15. The method of claim 10, wherein distributing is performed by the algorithm as a sequence of selections including a first selection and one or more subsequent selections, with each selection creating one of the subsets of the print data and a remaining portion of the data elements, and wherein each subsequent selection is performed by the algorithm on the remaining portion that is present when each subsequent selection is initiated.

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16. The method of claim 15, wherein creating the remaining portion for at least one of the selections includes comparing the subset created by the at least one selection with a remaining portion of the print data present when the at least one selection was initiated.

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17. A method of printing with a flexible number of passes, comprising:
obtaining print data corresponding to a pattern of dots of a colorant disposed at a subset of positions within an array;
obtaining at least one constraint limiting distribution of the print data and defining a minimum number of passes for permitted delivery of the colorant to at least substantially all of the positions of the array;
distributing the print data to a plurality of pass assignments corresponding to interspersed sub-patterns of the pattern, the number of pass assignments being less than the minimum number; and
delivering the colorant to overlapping regions of a print medium according to the plurality of pass assignments with a corresponding plurality of passes to form the pattern.

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18. The method of claim 17, wherein distributing is performed so that the number of pass assignments is configured to be a minimum permitted by the print data and the at least one constraint.

5 19. A program storage device readable by a processor, tangibly embodying a program of instructions executable by the processor to perform a method of printing with a flexible number of passes, the method comprising:

obtaining print data having a content defined by data elements corresponding to a pattern of dots of a colorant;

10 determining if at least one constraint on distribution of the print data exists so that forming the pattern in only one pass is precluded, and, if the at least one constraint exists, then:

(a) distributing subsets of the data elements, corresponding to interspersed sub-patterns of the pattern, to a number of pass assignments, the number and the subsets being determined by the content of the print data and the at least one constraint, and

15 (b) delivering the colorant to overlapping regions of a print medium with passes performed according to the pass assignments to form the pattern.

20. An apparatus for printing with a flexible number of passes, comprising:

a controller configured to obtain print data having a content defined by data elements corresponding to a pattern of dots of a colorant and also
5 configured to determine if at least one constraint on distribution of the print data exists so that forming the pattern in only one pass is precluded, the controller including a data distribution mechanism configured, if the at least one constraint exists, to distribute subsets of the data elements, corresponding to interspersed sub-patterns of the pattern, to a number of pass assignments, the number and
10 the subsets being determined by the content of the print data and the at least one constraint so that the pattern of dots will be formed on overlapping regions of a print medium with passes performed according to the pass assignments.

21. The apparatus of claim 20, wherein the data distribution mechanism
15 includes an algorithm and operates independently of predefined masks.

22. A system for printing with a flexible number of passes, comprising:

a controller configured to obtain print data having a content defined by data elements corresponding to a pattern of dots of a colorant and also
20 configured to determine if at least one constraint on distribution of the print data exists so that forming the pattern in only one pass is precluded, the controller including a data distribution mechanism configured, if the at least one constraint exists, to distribute subsets of the data elements, corresponding to interspersed sub-patterns of the pattern, to a number of pass assignments, the number and
25 the subsets being determined by the content of the print data and the at least one constraint; and

one or more image forming devices configured to deliver the colorant to the overlapping regions of a print medium with a plurality of passes corresponding to the number of pass assignments to form the pattern of dots.

23. The system of claim 22, wherein the one or more image forming devices include one or more printheads.

24. A system for printing with a flexible number of passes, comprising:
5 means for obtaining print data having a content defined by data elements corresponding to a pattern of dots of a colorant;
means for determining if at least one constraint on distribution of the print data exists so that forming the pattern in only one pass is precluded;
means for distributing, if the at least one constraint exists, subsets of the
10 data elements, corresponding to interspersed sub-patterns of the pattern, to a number of pass assignments, the number and the subsets being determined by the content of the print data and the at least one constraint; and
means for delivering the colorant to overlapping regions of a print medium with passes performed according to the pass assignments to form the pattern.

15 25. A method of printing with a flexible number of passes, comprising:
a step for obtaining print data having a content defined by data elements corresponding to a pattern of dots of a colorant;
a step for determining if at least one constraint on distribution of the print
20 data exists so that forming the pattern in only one pass is precluded, and, if the at least one constraint exists, then:
(a) a step for distributing subsets of the data elements, corresponding to interspersed sub-patterns of the pattern, to a number of pass assignments, the number and the subsets being determined by the content of the print
25 data and the at least one constraint, and
(b) a step for delivering the colorant to overlapping regions of a print medium with passes performed according to the pass assignments to form the pattern.